PTO 07-5023

CC=JP DATE=19921119 KIND=A
PN=04332573

GOLF CLUB HEAD
[Gorufu kurabu no heddo]

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UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. June 2007

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	JP
DOCUMENT KIND	(12):	A
	(13):	PUBLISHED UNEXAMINED PATENT APPLICATION (Kokai)
PUBLICATION DATE	(43):	19921119 [WITHOUT GRANT]
PUBLICATION DATE	(45):	19921119 [WITH GRANT]
APPLICATION NUMBER	(21):	03-132089
APPLICATION DATE	(22):	19910508
PRIORITY DATE	(32):	
ADDITION TO	(61):	
INTERNATIONAL CLASSIFICATION	(51):	A63B 53/04
DOMESTIC CLASSIFICATION	(52):	
PRIORITY COUNTRY	(33):	
PRIORITY NUMBER	(31):	
PRIORITY DATE	(32):	
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TITLE	(54):	GOLF CLUB HEAD
FOREIGN TITLE	[54A]:	Gorufu kurabu no heddo

(54) Name of this Invention /448*

Golf Club Head

[Claim(s)]

[Claim 1] Golf club head comprising of a double structure of an outer shell layer of high density metal and a core layer of low density metal, prepared by filling metallic powder in said outer shell layer and sintering the metallic powder.

[Claim 2] Golf club head according to Claim 1, wherein the outer shell layer is formed as a sintered body by a metallic powder injection molding method or a slip-cast method.

[Claim 3] Golf club head according to Claim 1, prepared by a step of separating the outer shell layer into a face surface part and a back face surface part, a step of arranging these parts to a temporary sintered state, a step of filling the inside of the outer shell layer created by combining the face surface part and the back face surface part with metallic powder for forming a core layer, and a step of sintering the metallic powder filled inside of the outer shell layer while completely sintering the outer shell layer at the same time so as to integrate the outer shell layer and the core layer.

* Numbers in the margin indicate pagination in the foreign text.

[Detailed Explanation of this Invention]

[0001] [Technological Field]

This invention pertains to a head of golf club and is particularly associated with a metallic golf club head so-called "iron golf club head".

[0002] [Description of the Prior Art]

The conventional iron head of a golf club is created by casting or precision casting (lost-wax casting) for forming a block of iron type alloy.

[0003] In the case of an iron-made golf club head, since the elastic modulus of iron is high at about 20,000 Kgf per 1 mm^2, the amount of elastic deformation of the face surface is small when a ball is hit by the head, and the contact time between the ball and face surface is short, thereby providing a satisfactory golf ball carrying distance. However, controlling the direction of hit ball is difficult.

[0004] Therefore, various club head designs were examined by modifying the shape of groove formed to the batting face surface or changing the center of gravity, resulting in the development of various club heads devised to provide a widened sweet spot and a large batting distance with effective spinning and trajectory.

[0005] Moreover, recently, various improvements were examined associated with the club head materials. For example, a golf club head consisting of a non-iron metal with an elastic modulus

significantly lower than that of iron, such as beryllium-copper alloy having the elastic modulus of about 12,000 Kgf per 1 mm^2, is made into a product by some companies.

[0006] [Problems to be Solved by this Invention]

However, no matter how much devises are provided to the design of the conventional golf club head made of iron, as the elastic modulus of iron is high as described above, it is difficult for a beginner to enjoy stable trajectory and large fly distance. On the other hand, a golf club made of a non-iron metal is not practical, as a dent or scratch is easily formed on the batting face.

[0007] Moreover, the number of golfers having weak strength (e.g., women and seniors) is increasing recently. To allow those golfers to enjoy sufficient fly distance, the head speed should be made faster by elongating the shaft length.

[0008] In this case, when the shaft is made longer, it becomes difficult to hit a ball accurately, as "swing and miss" and the like will occur. Therefore, the size of golf club head is preferably made slightly larger. However, as the relative gravity of the material is high at 7.2 - 8.9 in the case of an iron-made golf club head, when made larger, the golf club head becomes heavier. As a result, it becomes impossible for a golfer with weak strength to swing the golf club sufficiently.

[0009] Thereby, the purpose of this invention is to solve the abovementioned drawbacks of the conventional art by providing a golf club which allows a beginner and a woman/senior having weak strength to enjoy good flying distance and sufficiently stabilized trajectory.

[0010] [Means for Solving the Problems]

That is, this invention provides a head of golf club comprising of a double structure of an outer shell layer of high density metal and a core layer of low density metal prepared by filling metallic powder in said outer shell layer and sintering the metallic powder, where the outer shell layer is preferably formed as a sintered body by a metallic powder injection molding method or slip-cast method; more preferably, the head is prepared by a step of separating the outer shell layer into a face surface part and back face surface part, a step of arranging these parts into a temporary sintered state, a step of filling the inside of the outer shell layer created by combining the face surface part and back face surface part with metallic powder for forming a core layer, and a step of sintering the metallic powder filled inside of the outer shell layer while completely sintering the outer shell layer at the same time so as to integrate the outer shell layer and the core layer.

[0011] [Operation]

Since the golf club head based on this invention is configured as described above, providing a double structure of an outer shell layer of high density metal and a core layer of low density metal,

even when an iron alloy is used, the overall apparent specific gravity of the head becomes lighter, while the elastic modulus becomes lower. Moreover, these specific gravity and elastic modulus are flexibly adjustable by changing the thickness of the outer shell layer or changing the density of the core layer by modifying the granularity of the metallic powder filled inside of the outer shell layer.

[0012] With this configuration, since the surface of the head consists of a high density layer of a metal having strong mechanical strength, a dent or scratch is not formed to the surface of the head when the head is used to hit a ball. Moreover, as the overall elastic modulus is low, stable trajectory can be obtained. In addition, since slightly increasing the head size does not make the head heavier as the specific gravity of the head is small, a golfer with weak strength can obtain a long fly distance using a long shaft which can be swung freely. Thereby, a golf club designed flexibly according to various conditions of a user is easily provided.

[0013] Furthermore, by preparing the outer shell layer using a slip cast method or a metallic powder injection molding method utilizing extremely fine metallic powder having an average granularity of 10 μm or less, the outer shell layer can be easily formed into an arbitrary shape with a smooth surface with excellent measurement accuracy, and furthermore, with high density and strong mechanical strength. In addition, by dividing this outer shell layer

into a face surface part and a back face surface part, the outer shell layer can be formed more easily.

[0014] [Operational examples]

The following explains the operational example of this invention based on Figs. 1 - 4, where Fig. 1 shows a perspective view of the golf club head appearance based on the first operational example, and Fig. 2 is a cross-sectional diagram of the head thereof, illustrating the section A - A in Fig. 1. As clearly indicated with Fig. 2, the head is made into two layers comprising an outer shell layer 1 forming a hollow and a core layer 2 filling the hollow part of the outer shell layer 1. /449

[0015] The outer shell layer 1 is preferably formed of an iron alloy considering the mechanical strength. Using an SUS alloy as the iron alloy for example, the head is formed integrally into a high density sintered body based on the slip-cast method.

[0016] For forming the outer shell layer 1 using the slip-cast method, first, water (15 - 17%) and alginic acid ammonium (0.2 - 0.5%) used as a dispersant are added to SUS 316L powder having an average granular diameter of 9.4 μm, and the mixture is kneaded to prepare a slurry.

[0017] Next, the abovementioned slurry is injected into the gypsum cavity. When the water content in the slurry is absorbed into the gypsum mold from the cavity surface, forming a layer absorbed and adhered to the cavity surface, and the layer reaches a specific

thickness, the extra slurry in the cavity is discarded so as to drain the sludge.

[0018] Then, after the slurry layer absorbed and attached onto the cavity surface of the gypsum mold as described above is dehydrated and dried for one day and night, the dried molded body is separated from the mold to obtain a molded body. Lastly, by sintering this molded body at 100°C in the vacuumed atmosphere of about 0.001 torr for about 1.5 hours, a hollowed outer shell of temporarily sintered state is obtained.

[0019] The hollow section of the outer shell of temporarily sintered state is tap-filled with coarse iron powder (average grain diameter = about 100 μm; apparent density = 2.6 g/cm3). Then, the shell is sintered at 1250°C in the vacuumed atmosphere of about 0.001 torr for about 1 hour. As a result, a two-layer structured head consisting of an outer shell layer 1 made of completely sintered SUS and an iron core layer 2 is formed.

[0020] The golf club head prepared in this manner is a high density metallic sintered body consisting of an outer shell layer 1 with specific gravity of 7.7, having 3 - 4 mm thickness of face surface and 5 - 7 mm thickness of sole surface and a core layer 2 prepared as a low density metallic sintered body having a specific gravity of about 3.5. The overall head is made into a part which is light (specific gravity = 5) and has a low elastic modulus (13,000 Kgf/mm2).

[0021] Moreover, although not shown in the figure, according to the result of microscope observation, a bond layer is formed at the boundary of the outer shell layer 1 and the core layer 2, providing a strong bonding force to the outer shell layer 1 and the core layer 2. Therefore, it is not possible for the ball-hitting impact force to break the bonding of both layers 1, 2.

[0022] The following explains the second embodiment of this invention where the outer shell layer is formed by separating the face surface part and the back face surface part using a metallic powder injection molding method with the reference to Fig. 3 illustrating the cross-sectioned area of the head in the direction perpendicular to the face surface and with the reference to Fig. 4 illustrating the cross-sectioned area of the head in the direction horizontal to the face surface.

[0023] As clearly shown in the figures, the outer shell layer 3 is separated into the face surface part 4 which is the batting surface and the back face surface part 5 which is the opposite side of the face surface. Each part is separately created by a metallic powder injection molding method.

[0024] For forming the outer shell layer 3 using the metallic powder injection molding method, after adding an ethylene vinyl acetate resin for an amount ratio of 2.76% (weight %; hereafter the same shall be applied) and acrylic resin for an amount ratio of 1.85% used as thermoplastic resins, paraffin wax for an amount ratio of

4.52% used as wax, phthalic acid dibutyl for an amount ratio of 1.2% used as a plasticizer, and binder for an amount ratio of 1.2% to an SUS 304L (average granular diameter = 8 μm), the mixture is kneaded and formed into pellets. These pellets are used as an injection molding material and injection-molded based on the conventional method.

[0025] Next, the injection-molded product is heated slowly at a rate of 3 - 5°C/hour until the temperature reaches 200°C. Then, the binder included in the injection-molded product is melted and removed (binder elimination). This product not containing a binder is heated at 1000°C for about 1 hour so as to temporarily sinter the product.

[0026] The temporarily sintered face surface part 4 and back face surface part 5 obtained in this manner are combined so as to shape an outer shell layer 3, while coarse iron powder (average granular diameter = 100 μm; apparent density = 2.6 g/cm3) is tap-filled in the hollow section of the outer shell layer 3 prepared by combining the face surface part 6 and the back face surface part 5.

[0027] Lastly, the outer shell layer 3 in the temporarily sintered state, having its hollow part filled with coarse iron powder as described above, is sintered completely at 1250°C in the vacuumed atmosphere of 0.0001 torr for one hour. As a result, a golf club head consisting of two layers comprising an outer shell layer 3 made as a high density metallic sintered body having the specific gravity

of about 7.6 and a core layer 7 having the specific gravity of about 3.5 can be obtained.

[0028] The golf club head formed in this manner is light-weight, having an overall specific gravity of about 5 with an elastic modulus of 13000 Kgf/mm2 which is significantly lower than that of iron. Furthermore, the face surface part 4 and the back face part 5 in the temporary sintered state are strongly bonded by the complete sintering process, forming an integrated outer shell layer 3. Moreover, as this outer shell layer 3 and the core layer 7 form a bond layer to provide strong bonding, there is absolutely no possibility of separation of each bonded part when an impact force is applied at the time of ball-hitting.

[0029] Moreover, when a protruding weight part 6 having the thickness of about 15 mm is provided to a part of the back of the back face surface part 5 having the thickness of about 4 mm, and the size and position of this weight part are designed appropriately, a golf club head with a wide sweet spot can be provided.

[0030] In the embodiment described above, an SUS which is an iron alloy is used for the outer shell layer, and iron is used for the core layer. However, the use of other alloys including non-iron type alloys is completely acceptable according to the properties needed for the outer shell layer and core layer. Furthermore, physical properties can be improved by adding inorganic powder or a fiber material, such as carbon fiber, in the alloy.

[0031] In addition, the reason for forming the outer shell layer as a sintered body utilizing the slip-cast method or metallic powder injection-molding method is that, since they utilize metallic powder of extremely small granular diameter (10 μm or less), the prepared product has an extremely high density, strong mechanical strength, and moreover, a high precision measurement accuracy and extremely smooth surface. Also, the prepared product can be easily formed into an arbitrary shape without any post-processing. Furthermore, composing the inorganic powder and fiber material used for improving the physical properties is extremely easy and is convenient for producing a golf club head. In this case, a precision casting such as lost-wax casting may be certainly utilized to form the outer /450
shell layer.

[0032] Furthermore, although the embodiments described above are associated with an iron head, a metal-wood head may be formed using the same method, or the metal-sintering process may be replaced with a ceramic sintering process for producing a ceramic head.

[0033] [Effect of this Invention]

This invention with the configuration and operation as described above can easily adjust the overall specific gravity to about 4.0 - 6.0 by adjusting the thickness of the high density outer shell layer having the specific gravity of about 7.2 - 8.9 or by variously adjusting the granular diameter of the metallic powder filled in the hollow part of the outer shell layer within the range of 40 - 100 μm

and the specific gravity of the core layer within the range of about 2.0 - 4.0.

[0034] With this method, a golf club head which is light-weight and has a low elastic modulus and excellent surface strength can be easily produced. When this type of head is attached to a long shaft, a beginner and a woman/senior having weak strength can sufficiently enjoy the stable trajectory and large fly distance.

[Simple explanation of the figures]

[Figure 1] Perspective view of the first embodiment.

[Figure 2] Cross-sectional diagram illustrating the section A-A of the embodiment shown in Fig. 1.

[Figure 3] Cross-sectional diagram of the area of the second embodiment, which is the section perpendicular to the face surface.

[Figure 4] Cross-sectional diagram of the area of the second embodiment, which is the section parallel to the face surface.

[Explanation of Keys]

1...Outer shell layer; 2...Core layer; 3...Outer shell layer; 4...Face surface part; 5...Back face surface part; 67...Core layer

Figure 1

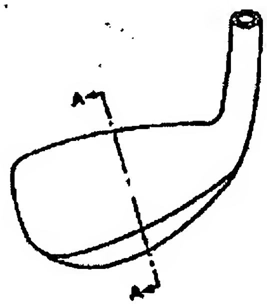

Figure 2

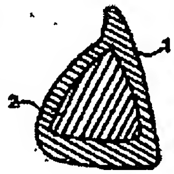

Figure 3

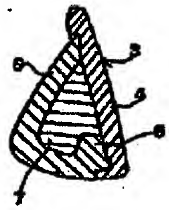

Figure 4